Nov. 15, 1955 S. TOUR 2,723,927

METHOD OF SCALE FREE FLAME HEATING OF METALS

Filed Oct. 20, 1953

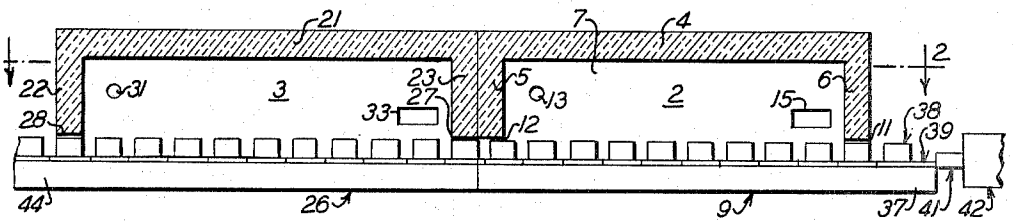

FIG. 1

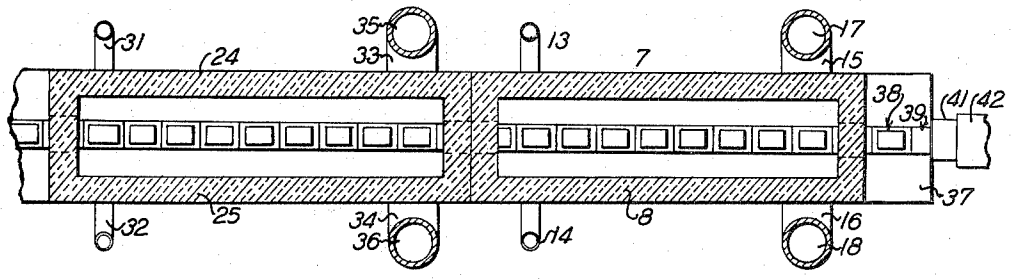

FIG. 2

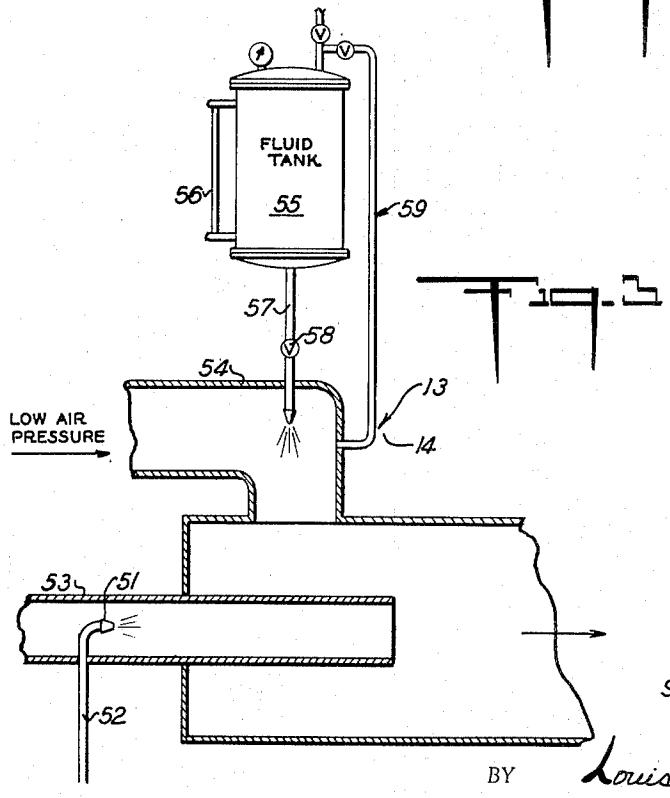

FIG. 3

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United States Patent Office 2,723,927 Patented Nov. 15, 1955

2,723,927

METHOD OF SCALE FREE FLAME HEATING OF METALS

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Application October 20, 1953, Serial No. 387,181

3 Claims. (Cl. 148—16.7)

This invention is a new and useful method of scale free flame heating of metals. It is particularly adaptable to gas, oil or powdered coal fired refractory lined furnaces in which the gaseous products of combustion of the fuel come in direct contact with the work being heated. The invention is especially useful in the heating of billets of iron and steel in preparation for working by rolling, pressing, forging, etc.

The invention will be fully understood from the following description read in conjunction with the drawings, in which:

Fig. 1 is a vertical section through apparatus in which the invention may be carried out;

Fig. 2 is a horizontal section through the showing of Fig. 1 on the plane indicated by 2—2; and

Fig. 3 is a vertical section through one element of the showing in Figs. 1 and 2.

Referring to the drawing, furnace 1 is composed of sections 2 and 3.

Section 2 is composed of refractory setting formed by roof 4, end walls 5 and 6, side walls 7 and 8, and floor 9. End walls 6 defines charge port 11 and end wall 5 defines discharge port 12. Section 2 is heated by burners 13 and 14 discharging directly into the interior. After traversing the length of the furnace, the gaseous products of combustion pass out through ducts 15 and 16 communicating with stacks 17 and 18.

Section 3 is composed of refractory setting formed by roof 21, end walls 22 and 23, side walls 24 and 25, and floor 26. End wall 23 defines charge port 27 and end wall 22 defines discharge port 28. Section 3 is heated by burners 31 and 32 discharging directly into the interior. After traversing the length of the furnace, the gaseous products of combustion pass out through ducts 33 and 34 communicating with stacks 35 and 36. Adjacent the charge port 11, the floor 9 extends outwardly, forming receiving apron 37. Billets 38 to be heated, preferably on palettes 39 of slightly greater horizontal extension, are positioned on apron 37 and moved into section 2 by pusher bar 41 controllably actuated by cylinder 42. A solid line 43 of such billets is maintained so that as one is moved into port 11, another moves out through port 12.

The line 43 of billets extends through section 3 so that as one billet moves into section 3 through port 27, another moves out through port 28 onto apron 44, from which it is removed (for working) in any suitable manner.

Burners 31 and 32 are of the conventional type, burning either oil or gas. A vertical section through burners 13 and 14 appears in Fig. 3. Oil or gas is introduced under pressure through nozzle 51 from pipe 52. High pressure air enters through pipe 53 surrounding nozzle 51. Low pressure air enters through pipe 54. Tank 55 provided with sight gauge 56 is adapted to hold a liquid

which may be fed into the low pressure air stream by gravity through pipe 57 controlled by valve 58. Pipe 59 extending from the interior of the burner to the upper end of tank 55 equalizes pressure between these points.

Tank 55 is charged with a volatile compound of boron in liquid phase. Examples of such compounds are the alkyl borates, i. e., methyl, ethyl and propyl borates, boron trichloride, etc. Organic solvents in which these compounds are soluble may also be present.

In operation, valve 58 is opened to permit the volatile boron compound to mix with the combustion gases and so enter the interior of section 2. The amount fed is correlated with the B. t. u.'s supplied to this section and ranges in general from $\frac{1}{20}$–2 pounds of elemental boron per million B. t. u. supplied.

Although the boron compound is preferably introduced into the gases passing through the burner, it may alternatively be introduced at any point where it will be quickly and thoroughly mixed with the combustion gases in section 2. In either case, it is present in the gases in section 2 as colloidal boric anhydride. This deposits selectively on the exposed surfaces of the metal billets, forming a film which inhibits oxidation.

In the preferred method of operation, the billets are heated in section 2 to a high red heat, for example, about 1700° F. and without substantial loss of heat, moved into section 3, in which they are heated to a higher temperature, for example, about 2400° F. Owing to the protective film developed in section 2, it is not necessary to supply the volatile boron compound to section 3, and no substantial oxidation will occur in carrying the billets up to the higher temperature.

The method of inhibiting oxidation in the heating of solid masses of metal in direct contact with gaseous products of combustion in a furnace, which method comprises introducing a volatile compound of boron into the atmosphere of the furnace, is the sole invention of the instant applicant. The method of operation, in which the billets are first heated in this manner with the resultant generation of a film of boron compound thereon and then transferred without substantial loss of temperature into a second furnace in which they are heated to a higher temperature and in which furnace no volatile compound of boron is introduced, is the joint invention of the instant applicant and another, and is claimed in a copending application.

I claim:

1. The method of inhibiting oxidation in the heating of solid masses of iron and steel in direct contact with gaseous products of combustion in a furnace, which comprises introducing into such a furnace with the gaseous products of combustion, a volatile compound of boron to the extent of at least $\frac{1}{20}$ pound of boron for each million B. t. u.'s of heat introduced.

2. Method according to claim 1 in which the volatile compound of boron is introduced to the extent of from $\frac{1}{20}$–2 pounds of boron for each million B. t. u.'s introduced.

3. Method according to claim 1 in which said volatile compound of boron is an alkyl borate.

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